Verlorenvlei, Jakkalsvlei & Wadrift Estuaries EWR

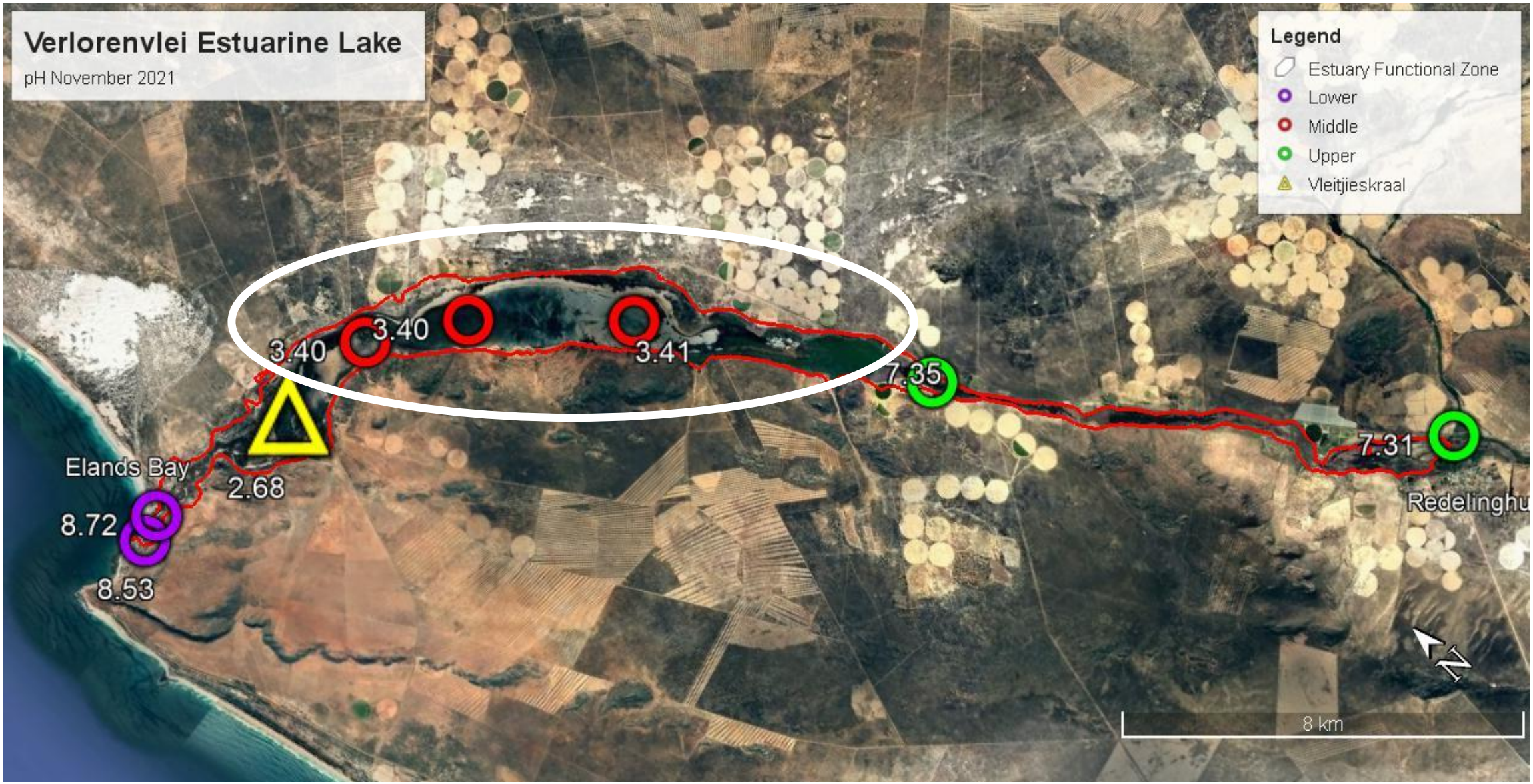
Verlorenvlei Estuary

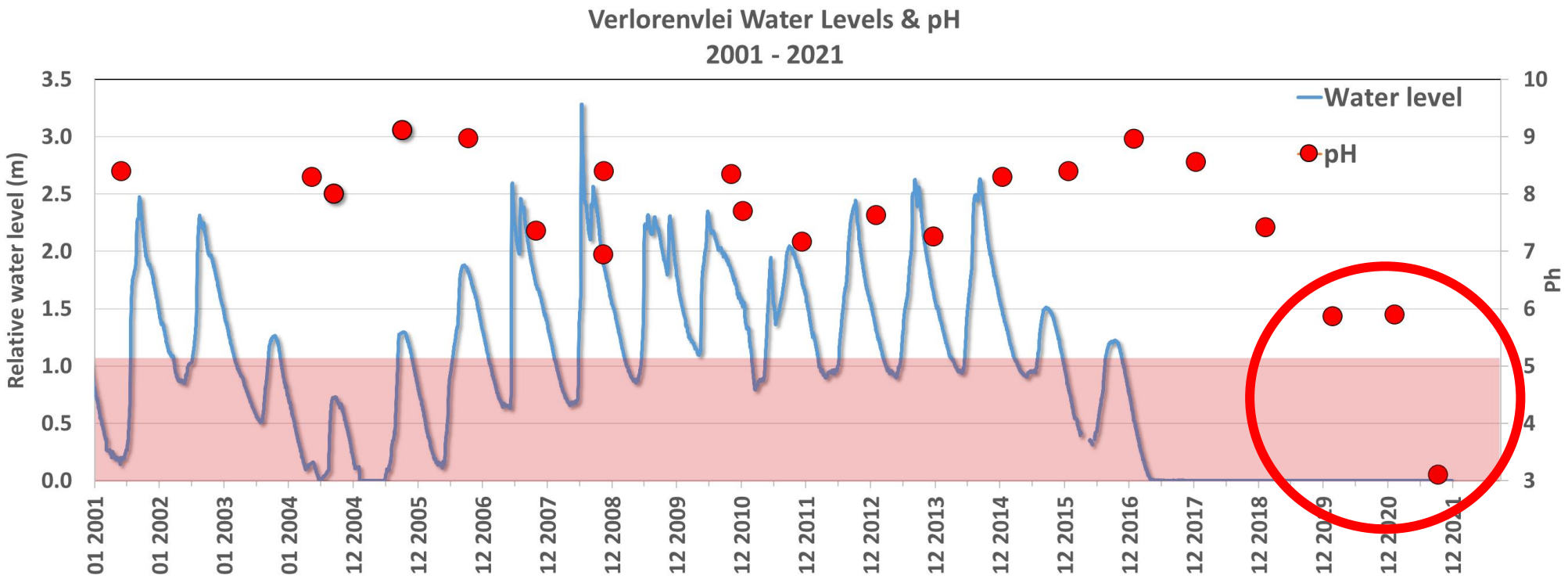
- Estuarine Lake on the Cool Temperate West Coast
- Ramsar site
- CapeNature in process of declaring formal protection
- Core priorities list of estuaries needed to meet Biodiversity Targets (NBA 2011)
- Until recently in a moderate to degraded state (D Category)…

Verlorenvlei

Preset Ecological Status

Variable	Present (2022)	Present (Simulated)	Confidence
Hydrology	42	67	VL
Hydrodynamics	0	53	M
Water quality	22	43	L
Physical habitat alteration	30	65	M
Habitat health score	24	57	
Microalgae	23	43	L
Macrophytes	45	55	M
Invertebrates	10	50	L
Fish	5	30	M
Birds	30	40	H
Biotic health score	23	44	
ESTUARY HEALTH SCORE	23	50	
PRESENT ECOLOGICAL STATUS	E ↓	D Recovery potential	
OVERALL CONFIDENCE	Medium	Low	

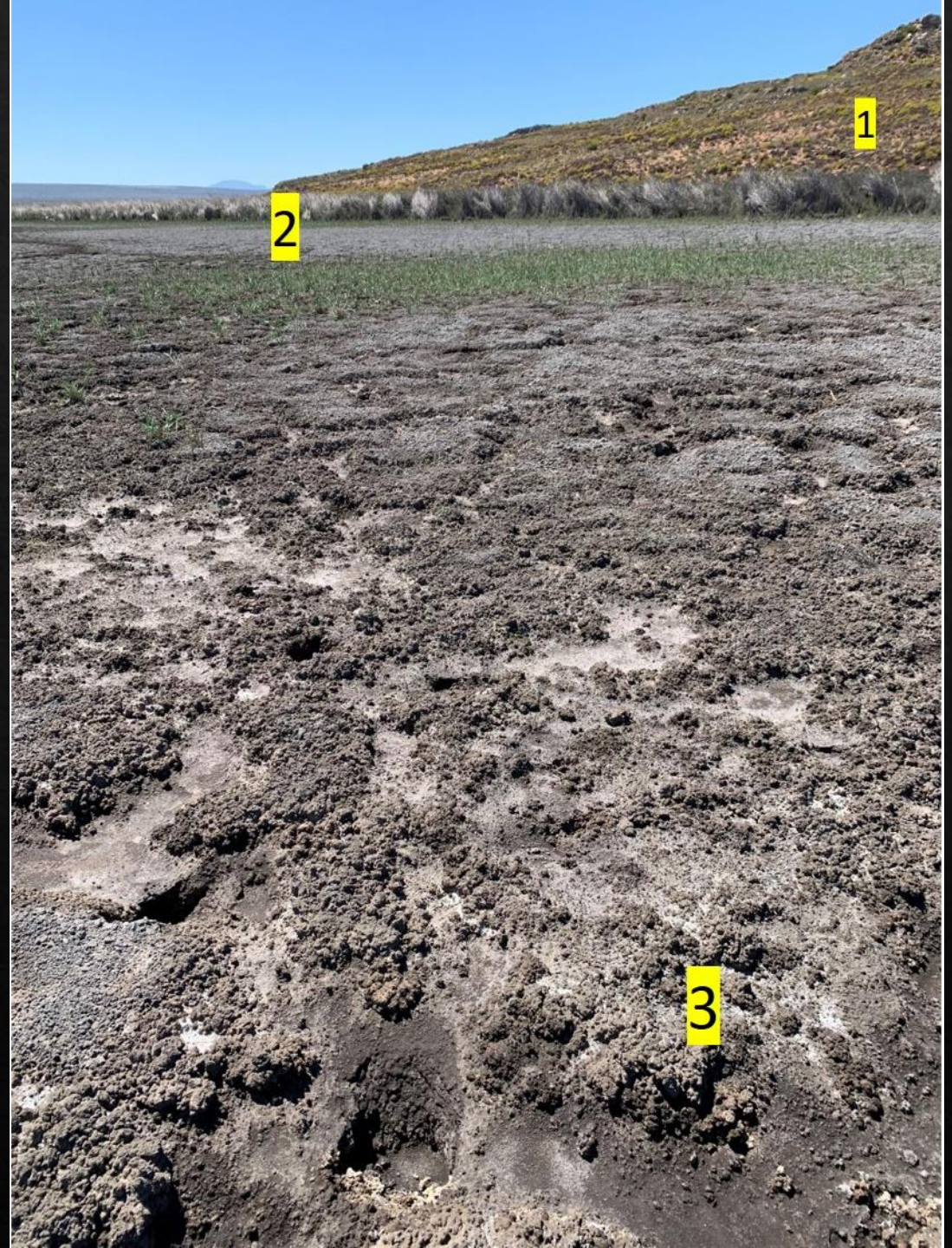

Verlorenvlei Estuarine Lake
pH November 2021
Legend
Estuary Functional Zone
Lower
Middle
Upper
Vleitjieskraal
3.40
3.40
3.41
7.35
7.31
Redelinghu
Elands Bay
2.68
8.72
8.53
8 km



pH- GEOSS South Africa (Pty) Ltd – Groundwater and Earth Sciences

PYRITE DISSOCIATION IN VERLORENVLEI


FEB 2019
ORANGE IN SMALL BASIN
Image © 2021 CNES / Airbus
Image © 2021 Maxar Technologies
Google Earth



- Peat/organic acid sulphate soils form under waterlogged/high lake water levels
- Dried out during the drought
- Iron sulphide minerals (pyrite) when exposed to air reacted with oxygen to form sulphuric acid & release iron & metals
- AFTER RAINS acid sulphate leachate

PES 2022

- **Salinity:** Lower: 140, Middle: 5, Upper: 1
- **Nutrients:** Extremely high ammonium concentrations (> 10 mg/l)
- **Microalgae:** Phytoplankton blooms (> 20 µg/l) in the vlei further contribute to pH stress
- **Macrophytes:** Recovering, but significant less reeds
- **Invertebrates:** No life in main basin but brine shrimp near the mouth & water boatmen upper reach
- **Fish:** No life in main water body
- **Birds:** No Flamingos, pelicans and cormorants

Verlorenvlei =E Category

Overall degradation of the system's health is largely attributed to the:

- Significant reduction in the freshwater inflow (both ground- and surface water) severely impacting lake levels and preventing rewetting after the climatic drought broke;
- Significant increase in nutrient loads to the system causing annual harmful blue-green agal blooms & feeding organic load in lake bed
- Illegal fishing activities & alien and translocated fish putting fish under severe pressure;
- Reduced connectivity (infilling at bridges and causeways) between parts of the system and impacting on connectivity with the sea and the upstream catchment.; and
- Removal of reeds (burning, grazing, trampling).

Recommended Ecological Category = B Category

Verlorenvlei Estuary Management Plan recommends minimum B/C Category

Future Scenarios

	Wt	Pres (2022)	Pres (Sim)	Sc 1 (50% increase)	Sc 2 (CC)
Hydrology	25	42	67	81	48
Hydrodynamics and mouth condition	25	0	53	67	42
Water quality	25	22	43	50	43
Physical habitat alteration	25	30	65	70	55
Habitat health score		24	57	67	47
Microalgae	20	23	43	45	43
Macrophytes	20	45	55	60	45
Invertebrates	20	10	50	60	35
Fish	20	5	30	50	10
Birds	20	30	40	50	25
Biotic health score		23	44	53	32
ESTUARY HEALTH SCORE		23	50	60	39
ECOLOGICAL STATUS		E	D*	C/D	D/E*
EHI after non-flow impacts removed		30	55	64	45
PES after non-flow impacts removed		E	D*	C	D*

Recommended Flow scenario = Scenario 1 (Restore 50% Surface water abstraction and storage)

Restoration to a B Category

- Reduce the levels of inorganic nutrients from the catchment & surroundings to halt the ongoing degradation.
  - Educate landowners/farmers & implement agricultural best practices
  - Address sanitation & sewage treatment in Redelinghuys & Elandsbaai
- Prevent illegal artificial breaching to increase water levels & ensure resilience to droughts under a future hotter/drier climate (EMP)
- Eradicate illegal gillnetting to ensure recovery / improve the resilience of fish
- Manage/eradicate alien and translocated fish - controlled commercial fishery
- Restore hydrological connectivity between the & vlei - removal of infilling and upgrade of road crossings (railway bridge, Grootdrift and Redlinhshuis causeways)
- Protect / restore reeds and sedges - act as nutrient filters and refuge areas
- Control infrastructure development & land use change in the Verlorenvlei EFZ
- Reinforce Ramsar status of Verlorenvlei - promulgation as a formal protected area
- Develop and implement a Climate Change Adaptation Plan for Verlorenvlei

Addional Baseline studies

- **Remote sensing study:** Sentinel 1 & 2 satellite imagery combined with LiDAR and/or Radar data analysis of what transpired during the 2016-2023 period when the DWS gauge stopped recording. Develop accurate volumetric relationship between the water level & open water area. Serve as a remote sensing observational platform/tool that can alert when water levels and/or openwater extent becomes dangerously low and water restrictions need to be imposed before lake acidification occurs in the future.
- **Field studies to determine the volume of water required to establish neutral pH conditions**. 'How easily will the system revert to a more neutral pH condition', i.e. how much dilution of the low pH water is needed by inflowing river water?
- **Long-term monitoring of sediments and metals (sediments and water column).** In addition to monitoring the water column conditions, it is also important that the sediment chemistry be regularly monitored (annually) to track below-ground recovery rates. Including risk metal precipitation poses during low pH acidic events (<4) to human health.
- **Development of a groundwater-surface water hybrid hydrological model** that accurately predict the inflow to Verlorenvlei during below average and flow drought conditions.

Recovery rate

- On going for >2 year
- Reset and restore freshwater inflow URGENTLY to rewet the system..
- Not much is known about the recovery process, but in Australian examples natural inflow stabilized one lake while another had to be treated with limestone...
- That means farming in the Sandveld will be impacted...

Jakkalsvlei

Preset Ecological Status

Variable	Present (2022)	Present (Remove other anthropogenic impacts)	Confidence
Hydrology	44	44	VL
Hydrodynamics	49	49	L
Water quality	56	72	L
Physical habitat alteration	60	72	L
Habitat health score	52	59	
Microalgae	49	49	L
Macrophytes	60	64	M
Invertebrates	50	53	L
Fish	50	60	M
Birds	55	60	M
Biotic health score	53	57	
ESTUARY HEALTH SCORE	53	58	
PRESENT ECOLOGICAL STATUS	D	C/D	
OVERALL CONFIDENCE	Low	Low	

Jakkalsvlei =D Category

Overall degradation of the system's health is largely attributed to the:

- Significant reduction in the freshwater inflow (ground- and surface water) to the estuary,
- Significant increase in the nutrient loads to the system;
- Removal/degradation of vegetation in the estuary functional zone; and
- Infilling near the mouth of the estuary (parking lot).

Jakkalsvlei: Low to average Importance

Recommended Ecological Category = D Category (maintain PES)

Future Scenarios

	Present	Sc 1 (50%↑)	Sc 2 (CC)	Conf
Hydrology	44	46	26	VL
Hydrodynamics and mouth condition	49	50	36	L
Water quality	56	56	54	L
Physical habitat alteration	60	65	50	L
Habitat health score	52	54	41	L
Microalgae	49	50	36	L
Macrophytes	60	65	40	M
Invertebrates	50	55	20	L
Fish	50	50	30	L
Birds	55	65	40	M
Biotic health score	53	57	33	L
ESTUARY HEALTH SCORE	53	56	37	L
ECOLOGICAL STATUS	D	D	E	

Recommended Flow scenario = PES (But protect groundwater)

Maintain D Category

- Reduce levels of inorganic nutrients in inflowing water from the catchment
  - Reduction in fertilizer use in the catchment
  - Educate landowners/farmers on the impacts of excessive fertilizer
  - Reduce direct inputs of inorganic nutrients into the estuary
  - Eliminate septic and conservancy tanks from properties on the banks of the Jakkals Estuary through the provision of sewage reticulation infrastructure
- Institute and enforce appropriate development set-back lines around the estuary that provide adequate protection for estuarine fauna and flora
- Improved compliance in respect of the use of living marine and estuarine resources (legal and illegal fishing)
- Investigate the removal of sediment at the mouth to restore connectivity, e.g. skimming the sand berm to a lower level

Wadrift


Wadrift Estuary
Legend
Estuarine Functional Zone
2 km
N
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2022 TerraMetrics
Image © 2022 Maxar Technologies

Preset Ecological Status

Variable	Present (2022)	Present (Remove other anthropogenic impacts)	Confidence
Hydrology	50	50	Low
Hydrodynamics	62	62	Low
Water quality	44	77	Low
Physical habitat alteration	50	90	Low
Habitat health score	52	70	Low
Microalgae	56	60	Low
Macrophytes	40	64	Medium
Invertebrates	40	58	Low
Fish	25	48	Low
Birds	45	48	High
Biotic health score	41	55	Low
ESTUARY HEALTH SCORE	46	63	Low
PRESENT ECOLOGICAL STATUS	D	C/D	
OVERALL CONFIDENCE	Low	Low	

Wadrift = D Category

Overall degradation of the system's health is largely attributed to the:

- Loss of connectivity with railway cutting across the system
- Significant reduction in the freshwater inflow (ground- and surface water) to the estuary,
- Significant increase in the nutrient loads to the system;
- Removal/degradation of vegetation in the estuary functional zone; and

Wadrift: Important Estuary

Recommended Ecological Category = C Category

Future Scenarios

	Present	Sc 1 (50%↑)	Sc 2 (CC)	Conf
Hydrology	50	63	27	50
Hydrodynamics and mouth condition	62	74	45	62
Water quality	44	46	43	44
Physical habitat alteration	50	55	40	50
Habitat health score	52	60	39	52
Microalgae	56	56	45	56
Macrophytes	40	45	20	40
Invertebrates	40	40	30	40
Fish	25	35	15	25
Birds	45	55	25	45
Biotic health score	41	46	27	41
ESTUARY HEALTH SCORE	46	53	33	46
ECOLOGICAL STATUS	D	D	E	D

Recommended Flow scenario = Scenario 1 (Restore 50% Surface water abstraction and storage)

Restoration to a C Category

- Urgently increase connectivity through bridges through the installation of more culverts and lower the floor level of exiting culverts to reduce salinity in lower part.

- Create novel/artificial wetland and buffer zones upstream where the peats used to occur (acting as a filter for nutrients and sediment). In turn, it will act as a refuge for invertebrates, fish, and birds during the drier periods and droughts, restoring some of the species diversity and abundance in the system.
- Improve agricultural practices to reduce levels of inorganic nutrients (fertilizers) and agrochemicals in inflowing water from the catchment
- Control overgrazing and trampling of saltmarsh in and around Wadrift Estuary to protect these critical habitats. Restoring such habitats in such stressful environments is very costly, and much more effective to manage and control the activities impacting them.

THANK YOU

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Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

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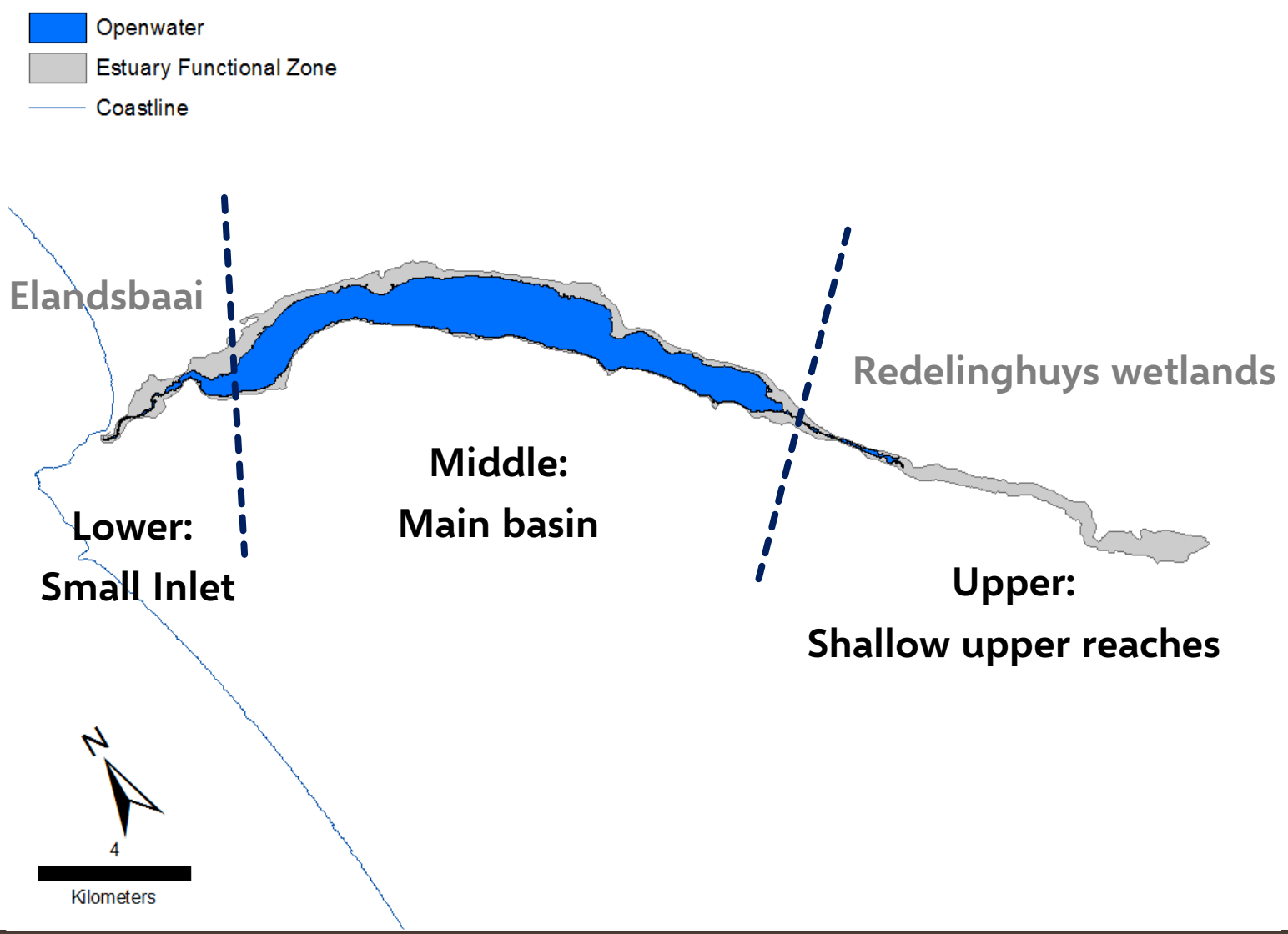
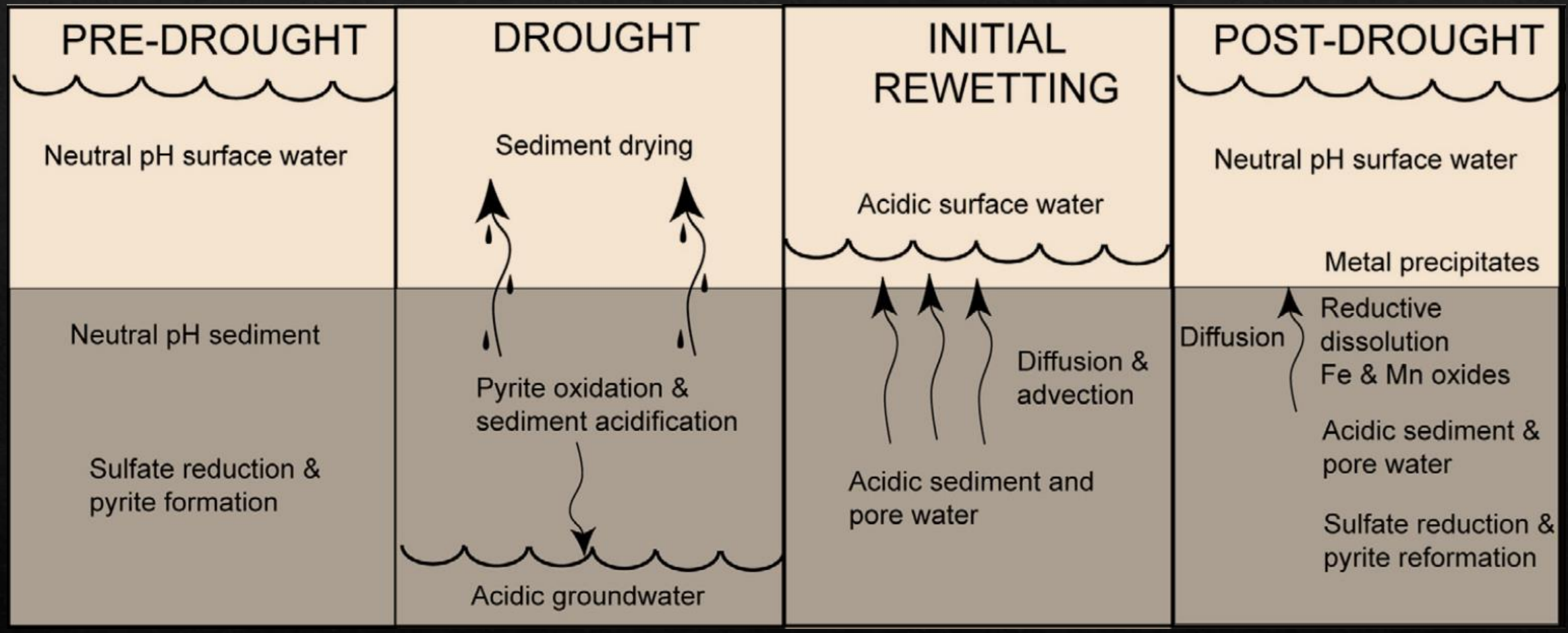
COASTAL & MARINE
RESEARCH

Questions?



Key features:

- Weakly connected to the sea over rocky sill
- Mouth closes and drive water level in the system
- Shallow, constricted inlet channel (Marine to Hypersaline)
- Deeper main basin (Fresh to brackish <6)
- Shallow upper reaches (Fresh <1)



Conceptual model of processes resulting in acidification of sediments and surface water during pre-drought, drought, initial rewetting, and post-drought conditions *(Mosley et al. 2014)*